Assessment and Grading in a Differentiated Mathematics Classroom

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Differentiated instruction provides a way for teachers to meet the needs of all students in a mathematics classroom. Some teachers, however, may be apprehensive about its implementation because of concerns related to assessment of student learning within this framework. This article explains how summative and formative assessments are both necessary and reasonable to perform within the differentiated mathematics classroom. The principles suggested are appropriate for any mathematics classroom, but a specific example is discussed in the area of fractions.

Introduction

Learning experiences are most successful when students find them relevant, engaging, and attainable. Students, however, vary with regard to what specific activities meet these requirements; the exact same learning experiences will not be equally effective for all students in a classroom (Tomlinson, 2005b). One strategy that has been found to address individual student differences is to support various levels of learning within one classroom – known as differentiating instruction. In a differentiated classroom, instruction is varied in some way based upon individual student's needs. The practice of teaching mathematics using differentiated instruction is a way for teachers to ensure that all students take part in learning worthwhile mathematics. The result is greater student engagement, achievement, and equity. This article will discuss the role of formal and summative assessment in a differentiated mathematics classroom, regardless of content or level. A unit on fractions will serve as a specific example to illustrate the major principles presented.

Framework for Differentiation

Development of differentiated instruction should begin with the identification of big ideas and key objectives for a lesson or unit (Small, 2009). Big ideas give teachers a framework for determining important understandings that students should possess when instruction has concluded. A teacher can then differentiate instruction by ensuring that the big ideas are addressed at the levels appropriate for individual students; this encourages a focus on important mathematics at all times, for all students. Any mathematics unit must have clear objectives in order for differentiated instruction to be effective, regardless of the specific topic being taught.

For a unit about fractions, the big ideas may be that students:

- Develop a deep meaning of fractions as both parts of wholes and ratios.
- Identify and generate equivalent fractions
- Compare and order fractions.

Once big ideas have been identified, instructional decisions can be made to account for the diverse needs students present. Differentiation will then take the form of specific tasks varied based upon each individual student's mathematical characteristics. Differentiated instruction is typically based upon at least one of the following student characteristics: readiness, interest, and learning profile (Tomlinson, 2005b). In this way, instructional decisions

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take into account students' previous experiences and understandings, as well as their interests and ways of learning.

As teachers prepare a unit on fractions, they might ask several questions to gain clarification about these three student learning traits. Is the student ready to learn fractions? In this example, readiness may include an understanding of whole number concepts, operations, part/whole concepts, and proportional reasoning. The teacher might also consider if students have had previous experience with fractions and precisely what meanings students associate with the concept. As the unit progresses, readiness differentiation may continue to take place as the complexity of specific tasks is altered to meet the needs of individual learners. Some students may work with only unit fractions as they learn about equivalence. Individual students may also compare different sizes or numbers of fractions. In what contexts may the student find interest in fractions? Some students may use a food-based project to develop ideas while others use sports-based examples. What learning profile characteristics need to be considered in order to make learning fractions meaningful for the student? This may include grouping configurations (large group, small group, or individual) or type of activity (oral, written, or kinesthetic).

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Based upon student traits described above, differentiated instruction then involves the following classroom components: content, process, and product. Content is what a teacher teaches and expects students to learn. When students are offered choices as to how they are taught information, the learning process is being differentiated; this may include learning activities used to teach concepts and other variations in the ways students acquire knowledge. Finally, learning products can be differentiated. These are more long-term artifacts than the activities typically used to differentiate processes. When a product is differentiated, students are given multiple ways to express the content they come to understand through a learning process. A teacher may provide many different ways for a student to demonstrate knowledge acquired such as tests, portfolio assignments, and projects. Product assignments can be differentiated to accommodate different readiness levels or to allow student choice based upon interest, although it may be at times appropriate to give all students in a classroom the same examination to assess mastery.

Differentiation of content, process, and product can be considered within the example of a fraction unit. Content differentiation is typically only done for extremely linear content so it would not be a good match for this unit. The fraction unit should, however, include differentiation of learning process. For example, some students may require extensive use of manipulatives or technology to develop valid meanings of the fraction concept. Others may be able to work at a more abstract level. The learning process may also be differentiated by providing different versions of the same task allowing students to work with fractions in an appropriate level of complexity for their learning needs. Finally, the learning products should be differentiated. Teachers may elect to give various versions of examinations or may design an end-of-unit project that allows students to express their understanding of fractions at their current levels. These examples show that instruction can be altered in several ways, yet still be rooted in the big ideas for the unit.

Overcoming the Assessment "Barrier"

The framework described above provides a way for teachers to use differentiated instruction to promote equity and to enable all students to learn mathematics. One reason many teachers shy away from differentiated instruction, however, is because of fears related to the difficulty of grading students who are working on different activities

(Tomlinson, 2005a). Tomlinson states that no conflict can be found in the underlying tenets of differentiated instruction and those of grading, thus the goals of the two are actually similar. Effective teaching can blend aspects of the two into high-quality instruction. Both practices require clear and stable criteria, but there is no reason that different paths cannot be taken by students toward achievement of goals. Student grades can remain valid while also encouraging individual growth. Therefore, the barriers to blending the two teaching practices are not based upon clearly defined theoretical differences between them, but rather are erected from misperceptions and deeply entrenched beliefs about how each should be done. Although these beliefs may be inconsistent with the major tenets of either differentiated instruction or effective grading, Tomlinson believes that teachers can change their attitudes and practices if they seek to carefully implement differentiation along with solid assessment procedures (Tomlinson, 2005a).

A guiding principle related to assessment within a differentiated classroom is that some assessment is *for* learning and some is *of* learning. Not all work has to be formally graded. A key suggestion for teachers who feel overwhelmed by the prospect of grading in a differentiated classroom is to carefully consider what type of task students are working on. Long-term assignments and/or tests can provide most evidence of what students learn, while daily process activities may be monitored less formally. For all assessment in a differentiated classroom, a teacher may ask two questions: What information can be obtained from this activity in order to continue to make the best instructional decisions to match each student's characteristics? Should this activity be part of students' grades? These questions render clarification as to the type of assessment information to be gained from any given task.

Formative Assessment - What do students know?

Much of the work that students do within a differentiated classroom should be done for the purpose of learning and not explicitly for obtaining a grade. These mathematical process tasks can thus be differentiated to accommodate student characteristics without undue concern over formal grading. Gaining information about student learning as it is occurring in order to make instructional decisions is known as *formative assessment.* Although such work does not contribute to grades, these tasks provide valuable information for teachers. Student progress can be tracked using information garnered from a variety of sources, such as homework, classroom discussions, or short ungraded quizzes. Teacher evaluation of tasks completed in class can provide important information about a student's mathematical understanding and then be used to further differentiate instruction.

Formative assessment about student learning must still be managed by teachers in some manner, even if it does not explicitly count toward a grade. One way this may occur is through the use of a log of student understanding (Chamberlin & Powers, 2010). This log can contain a list of learning objectives for a certain lesson or unit, along with two or three columns designating different levels of student understanding. These can be used during instructional time to record student demonstrations of learning in class.

Figure 1 gives an example of a log of objectives for one of the big ideas in a fraction unit: generating equivalent fractions. To fill out the chart, the teacher uses observations of student learning to determine if the student is meeting two related goals: identifying and generating equivalent fractions. Information can be gathered from classroom discussions, student discussions in small groups, or teacher

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	Objective: Identify equivalent factions			Objective: Generate equivalent fractions		
Student name	No understanding evident	Emerging Understanding	Mastered	No understanding evident	Emerging Understanding	Mastered
Jones, M.	x				x	
Johnson, L.			x	x		x
Smith, K.		x			x	

Fig 1 Log of objectives for fraction unit

evaluation of individual work. A similar log can be created for the big ideas in any mathematics unit by changing the objective listed at the top of the chart. Chamberlin and Powers (2010) report that this is an efficient way to monitor student progress toward major learning goals.

There is evidence that computer-based monitoring systems can also aid teachers in making instructional decisions, increase student achievement, and improve student attitudes toward learning (Ysseldyke & Tardrew, 2007). One system used with differentiated mathematics instruction requires students to complete daily practice sets of problems and then input answers into a computer using a scan sheet. The problem sets are generated by the computer system and assigned by the teacher based upon information from previous assessments. In this way, the teacher need not make up daily problem sets for various students but can instead use information organized by the computer to choose which set of problems each student should work on. This monitoring system allows teachers to get a quick glimpse of student levels on a frequent basis and then further differentiate instruction.

However it is recorded, this information is based upon general objectives and thus consistent with the general framework used to plan differentiated instruction. Formative assessment information is the foundation for instructional decisions about student readiness. When teachers gain more information about what their students know, they can then determine how to further differentiate instruction to meet students' varying readiness needs.

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Summative Assessment – How are grades assigned?

Although much work that students do in a differentiated classroom should be assessed in a formative manner as discussed above, grading is still an important aspect of teaching and learning.

Students must be formally evaluated at some point to determine their progress toward class objectives. This type of assessment is known as summative assessment and is useful for analyzing where students are at a particular point in time. Anything that is part of students' grades should reflect mastery of objectives or state/national indicators. This is a basic tenet of effective grading, but it correlates directly with the practice of differentiating instruction because of the focus on big ideas (Tomlinson, 2005a).

Grades should primarily be based upon large product assignments that assess understandings for a lesson or unit. This may seem complicated if students are completing different versions of examinations or projects. A rubric, however, can help the teacher focus on the lesson or unit objectives and the different levels to which students have mastered them. Rubric-based summative assessment can help teachers clarify and quantify student understanding at a given point in time, allowing grades to be assigned.

For a fractions unit, a teacher may choose to assess student understanding by giving a test or project assignment. This assessment should include evaluation of individual student's ability to identify and generate equivalent fractions, since this is one of the main ideas for the unit. Although all students may have learned differently and may even be assessed in various ways, a rubric like that shown in Figure 2 allows the teacher to determine each student's current understanding of fraction equivalence. A summative assessment rubric for the entire unit would also include information about the other two big ideas for the unit: fraction meaning and comparisons. In this way, a teacher can assign a score to student understanding at the conclusion of a unit. This can serve as the primary grade for the unit of instruction.

Equivalent Fractions			
Identify			
Level 0 No demonstration of identification of equivalent fractions.	**Level 1** Some correct identification of equivalent fractions. Work does not demonstrate a clear understanding of equivalence.	**Level 2** Correct identification of equivalent fractions. Work does not always demonstrate a clear understanding of equivalence.	**Level 3** Consistently correct identification of equivalent fractions. Work demonstrates a clear understanding of equivalence.
Generate			
Level 0 No demonstration of generation of equivalent fractions.	**Level 1** Some correct equivalent fractions are generated. Work does not demonstrate a clear understanding of equivalence.	**Level 2** Correct equivalent fractions are generated. Work does not always demonstrate a clear understanding of equivalence.	**Level 3** Consistently correct equivalent fractions are generated. Work demonstrates a clear understanding of equivalence.

Fig 2 Formative assessment rubric

Summative assessment information from product assignments may also be used to make further instructional decisions for the next unit. A teacher may determine from assessment data that re-teaching certain aspects is necessary before particular students can move on to a related topic. If the topic to follow the example fraction unit will pertain to decimals and percents, a teacher can use the rubric scores to easily identify each student's level of readiness for upcoming instruction.

Overall grades in a differentiated classroom may also consider the smaller-scale learning process tasks completed throughout a unit if a teacher desires. When activities such as classwork or homework tasks are to be part of a grade, teachers may wonder how to incorporate them, considering that students do not all perform the same tasks using identical methods. Traditionally, a teacher creates a column in his or her gradebook for each activity students complete. Because there may be several versions of a teaching activity going on concurrently in a differentiated classroom, the teacher need not try to record student performance of every single task. (Most of this process-type work should be ungraded, and simply used as a student learning tool and teacher decision-making tool as described in the previous section.) As a solution to the complications of several simultaneous activities in a classroom, any

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grades for these smaller learning activities should be based upon broad categories of mastery rather than restricted to specific assignments. Regardless of the level of complexity or other particulars of a certain task, all students should be evaluated based upon the general objectives for the unit.

For the fraction unit, the objectives of identifying and generating equivalent fractions may be taught using several different activities for various students, assigned either by student or teacher choice. Some students may use manipulatives at all times. Some may perform the task using large, challenging fractions while others work with small unit fractions only. Regardless of which particular task a student is working with or the methods for learning, a grade may be entered for the general category of "Generating Equivalent Fractions."

The fact that students in a classroom take different routes to gain knowledge does not inhibit their demonstration of that knowledge from being used to assign grades. Using the methods described above to assign grades allows teachers to use any preferred method for communicating progress to students and parents. Grades required for progress reports or grade cards can be generated by combining scores from a test or project with several grades on smaller assignments.

Conclusion

The field of mathematics education faces many challenges, including that of educating students in an equitable manner within mixed-ability classrooms. Differentiated instruction provides one method of meeting student needs equitably. Differentiated instruction does not, however, offer a quick or simple solution for the issues associated with equity. Instead, the beliefs that underlie the practice of differentiated instruction allow teachers to make flexible and fair instructional decisions. Differentiated instruction can help develop equity in the mathematics classroom. Assessment should be seen as a tool for improving all students' learning rather than as a hindrance to differentiating instruction. When a teacher carefully uses assessment to ensure that the mathematical needs of students in the classroom are met and quality learning takes place for all, efforts toward the achievement of equity can be considered successful.

References

Chamberlin, M., & Powers, R. (2010). The promise of differentiated instruction for enhancing the mathematical understandings of college students. *Teaching Mathematics and its Applications, 29*, 113-139.

Small, M. (2009). *Good Questions: Great ways to differentiate mathematics instruction.* New York, NY: Teachers College Press.

Tomlinson, C.A. (2005a). Grading and Differentiation: Paradox or good practice? T*heory into Practice, 44*(3), 262-269.

Tomlinson, C.A. (2005b). *How to differentiate instruction in mixed-ability classrooms (2nd ed.)*. Upper Saddle River, NJ: Pearson Education, Inc.

Ysseldyke, J., & Tardrew, S. (2007). Use of a progress monitoring system to enable teachers to differentiate mathematics instruction. *Journal of Applied School Psychology, 24*(1), 1-28.

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